EL792821057

SYSTEM AND METHODS FOR SMOOTHING SENSED TONER LEVELS

Inventor:

Trevor Wells
Kevin A. Owen

ATTORNEY'S DOCKET NO. 10010621-1

SYSTEM AND METHODS FOR SMOOTHING SENSED TONER LEVELS

TECHNICAL FIELD

The present invention relates to sensing toner levels in print device toner cartridges and, more particularly, to the smoothing of percent degradation values of sensed toner levels to present a uniform reduction in toner over the lifetime of a toner cartridge.

BACKGROUND

Consumable items in printing devices mostly include "marking agent" components that are consumed with each printed page as part of the printed product, and rotating components that deteriorate over time as a result of wear and tear. Marking agent consumables include ink, wax, powder toner, thermal agents, and the like. Marking agents are often housed in some type of cartridge, such as a toner cartridge, and dispensed onto rotating components that transfer the agents to a print medium during a printing process. As a marking agent is depleted, it is useful to have information about the amount of agent remaining in a cartridge in order to approximate the number of pages available for printing during the remaining life of the cartridge. Various methods exist that provide information regarding the remaining useful life of a cartridge.

A page counting method does not involve direct measurement information about the level of toner (i.e., marking agent) present in a cartridge. Instead, this method provides an expected life span for a toner cartridge measured by the number of pages that the cartridge is expected to print. The life span is reduced by one page for each page that is printed. A disadvantage of this simple method is that it can be inaccurate.

The inaccuracy of this method can result from at least two factors. First, the expected number of pages available from a toner cartridge is a rough estimate set by the

cartridge designer based on numerous examples of like cartridges. The actual number of available pages can vary significantly from cartridge to cartridge. Second, the amount of toner put on each printed page may vary dramatically from page to page. These factors often mean that more or less toner is left in a cartridge than expected, which can result in significant differences in the number of pages expected to be printed and the number of pages that can actually be printed by a given cartridge.

A pixel counting method also does not involve direct measurement information about the level of toner present in a cartridge. Rather, this method starts with an assumed maximum number of pixels available to be expended over the life of the cartridge. In a color laser printer, the number of pixels expended can be estimated by tracking the number of laser pulses used to magnetize a photoconductor drum. Four laser pulses will magnetize the drum to statically charge one pixel. The number of laser pulses can be measured for each printed page, and the appropriate number of pixels can be subtracted from the maximum pixels available, thereby providing a measure of the percentage of pixels (i.e., toner) remaining in the cartridge.

Unfortunately, this method suffers disadvantages similar to the previous method. The maximum number of available pixels is assumed by the cartridge designer based on numerous examples of like cartridges. The actual number of available pixels can vary significantly from cartridge to cartridge. In addition, counting laser pulses can be an inaccurate method of determining the number of expended pixels on a printed page. Although the error per page may be slight, it can add up over the life of the cartridge (e.g., 10,000 printed pages) and create a significant difference in the expected percentage of toner available and the actual percentage of toner available. Moreover, the largest errors are seen toward the end of the cartridge life cycle, which is the time when it is most important to have accurate toner level information.

Another method of determining the toner level within a cartridge utilizes antenna sensor technology. This method provides direct information about the level of

toner in a cartridge by passing current from one end of the cartridge to the other through an antenna. The current induces voltage signals in coils within the cartridge that are proportional to the amount of toner present in the cartridge. Although this direct measurement of the toner level is beneficial, it too has disadvantages.

Most toner level antenna sensors provide readings that have a wide degree of deviation. The jostling or movement of toner within a cartridge can cause the voltage signals from the antenna sensor to vary by as much as 16 to 20 percent between readings. Toner movement is significant in carousel-arranged cartridges that rotate during a color print process to provide access to the different color toners. The deviation in toner readings can occur as often as every sample interval, such as after every printed page. Reported toner levels may jump drastically and provide no real sense of the actual toner level. For example, a user may notice that the reported toner level jumps from a lower value to a higher value even though significant printing has occurred between the two readings. Therefore, for any given toner level reading, a user is not really sure of how much toner remains in the cartridge. In addition, such deviation does not provide a uniform decrease in the reported toner level over time, and therefore does not ensure a level of predictability as to the remaining life of a toner cartridge.

Accordingly, the need exists for a way to accurately determine the amount of toner within a toner cartridge and to report this information in a manner that permits predictability as to the remaining useful life of the toner cartridge.

SUMMARY

A printer system senses toner (or other marking agent) levels in a toner cartridge and executes an algorithm to smooth the sensed levels. The smoothing algorithm provides toner level reports that follow a uniform percent degradation in reported amounts of toner over the life of a toner cartridge, which in turn, permits a higher level of predictability as to the remaining life of a toner cartridge and the number of pages available for printing from the cartridge. The algorithm accounts for the inaccuracies of hardware supply level sensors and prevents the need for more complex and costly hardware sensors.

When a print device is powered up or a toner cartridge within the device is removed and replaced, the algorithm executes to set the toner report level to an arbitrary value. The arbitrary value is preferably higher than 100% and serves to indicate to a user that the toner report level is in an unknown state.

The algorithm then seeds the toner report level with an initially measured value. The seeded value is determined by receiving a number of readings from a toner level sensor (e.g., an antenna sensor) on the cartridge and selecting the highest reading as the seeded value.

After the toner report level is seeded, a group of toner level sensor readings is received and averaged. The report level is set to the average value of these readings if the average value is less than the seeded toner report level. A second group of toner level sensor readings is then received and screened to ensure that each reading is within a prescribed percent (e.g., +/- 10%) of the report level. Readings that are not within the prescribed percent of the report level are presumed to be inaccurate, and thus rejected. A preset number of screened readings is then averaged, and if the average value of this group of readings is less than the seeded toner report level, the report level is set to the average value.

From then on, throughout the life of the toner cartridge, the toner report level is adjusted downward accordingly by averaging subsequent groups of toner level sensor readings and setting the report level to those average values that are less than the current report level. Again, all readings within subsequent groups are screened to ensure they fall within a prescribed percent of the current toner report level in order to eliminate outlying values that are presumed to be inaccurate.

BRIEF DESCRIPTION OF THE DRAWINGS

The same reference numbers are used throughout the drawings to reference like components and features.

Fig. 1 illustrates a workstation and a printing device as a suitable system environment in which to smooth sensed marking agent supply levels from a printing device cartridge.

Fig. 2 is a block diagram illustrating a system such as that in **Fig. 1**.

Fig. 3 illustrates a printer device which uses a number of toner cartridges and various other consumable components.

Fig. 4 is a flow diagram illustrating an example method of smoothing toner level sensor values and setting toner report levels throughout the life of a toner cartridge.

Fig. 5 is a flow diagram illustrating a more detailed example of a method of smoothing toner level sensor values and setting toner report levels throughout the life of a toner cartridge.

Figs. 6-8 are flow diagrams illustrating example implementations of each stage of the method of **Fig. 5**.

DETAILED DESCRIPTION

The system and methods described herein relate to reporting the supply level of a marking agent (e.g., toner) in a print device cartridge. An algorithm executes to smooth over inaccuracies in measured values received from a hardware supply level sensor. Through seeding an initial report level and adjusting that level based on average groups of sensor readings that exclude outlying values, the algorithm facilitates supply level reports that follow a naturally decreasing trend throughout the life of a print device cartridge.

Exemplary System for Smoothing Sensed Toner Levels

Fig. 1 illustrates an example of a printing system that is suitable for smoothing sensed toner levels from a toner cartridge in a print device. The system **100** of **Fig. 1** includes a printer device **102** connected to a host computer **104** through a direct or network connection **106**. Network connections **106** can include LANs (local area networks), WANs (wide area networks), or any other suitable communication link. The invention is applicable to various types of printing devices that make use of marking agent consumables such as ink, wax, powder toner, thermal agents, and the like. Therefore, printer device **102** can include devices such as copiers, fax machines and scanners, and may also include multifunction peripheral (MFP) devices which combine the functionality of two or more peripheral devices into a single device.

In general, the host computer **104** outputs host data to the printer device **102** in a driver format suitable for the device **102**, such as PCL or postscript. The printer device **102** converts the host data and outputs it onto an appropriate recording media, such as paper or transparencies.

Fig. 2 illustrates the printer system **100** in more detail. The printer device **102** has a controller **200** that processes the host data. The controller **200** typically includes a data processing unit or CPU **202**, a volatile memory **204** (i.e., RAM), and a non-volatile

memory **206** (e.g., ROM, Flash). Printer device **102** includes a print engine **208** and one or more consumable printing components **210**. Consumable(s) **210** represent marking agents typically housed in cartridges whose supply levels decrease with each printed page output by print device **102**. Therefore, consumable(s) **210** generally include cartridges and other containers that hold ink, wax, powder toner, thermal agents, and the like. Other typical print device consumables such as paper, photoconductors, transfer drums or belts, and fusers are not illustrated in **Fig. 2**, but are discussed below with reference to **Fig. 3**.

Consumable(s) **210** include monitoring devices **212** located either on the print device **102** or on the consumable **210** itself. The monitoring devices **212** monitor the toner (i.e., marking agent) supply levels within consumables **210**. Monitoring devices **212** are preferably antenna sensor devices that measure supply levels within a cartridge by passing current from one end of the cartridge to the other through an antenna. The current induces voltage signals in coils within the cartridge that are proportional to the amount of toner present in the cartridge.

As discussed in the background section, most toner level antenna sensors **212** provide readings that have a wide degree of deviation caused primarily by the movement of toner within a cartridge. The invention directly addresses the deviation in such sensor readings. Therefore, although monitoring devices **212**, or toner level sensors **212**, preferably consist of antenna sensor devices, they can include any level sensor device that is prone to providing readings that vary based on factors other than the true level of toner or marking agent present within a cartridge.

The printer controller **200** processes host data and manages the print process by controlling the print engine **208** and consumable(s) **210**. Printer controller **200** includes printer driver software **214** executing on CPU(s) **202**. The printer driver software **214** is stored in memory **206** and includes a smoothing module that executes to smooth over toner supply level readings received from monitoring devices **212**. The smoothing

module **214** facilitates the printer system **100** in providing reports to system users on the percentage of toner or other marking agents remaining in a print device **102** cartridge. The reports can be output on print device **102**, the host computer **104**, or any suitable display device coupled to print device **102**. Although the printer driver software **214** and smoothing module generally execute on print device **102**, they may also be stored and execute on the host computer **104** as illustrated by printer driver **222**.

The host computer **104** includes a processor **216**, a volatile memory **218** (i.e., RAM), and a non-volatile memory **220** (e.g., ROM, hard disk, floppy disk, CD-ROM, etc.). The host computer **104** may be implemented, for example, as a general-purpose computer, such as a desktop personal computer, a laptop, a server, and the like. The host computer **104** may implement one or more software-based printer drivers **222** that are stored in non-volatile memory **220** and executed on the processor **216** to configure data into an appropriate format (e.g., PCL, postscript, etc.) and output the formatted data to the printer device **102**.

<u>Exemplary Print Process For Smoothing Sensed Toner Level Values</u>

Fig. 3 represents a color laser printer **300** as an example print device **102** that may be used in the printing system **100** of **Figs. 1** and **2**. A general printing process will now be described with respect to color laser printer **300** for the purpose of illustrating a context for smoothing sensed supply level values and reporting the percentage of toner or other marking agent remaining in a print device **102** cartridge.

A typical color laser printer **300** produces an image using various colored toners. During an imaging process, a four color image is built sequentially onto a transfer element, such as an intermediate transfer belt **308**, before it is finally transferred to the print medium (e.g., paper or transparency) in one pass. The ultimate application of the toners to the print medium is controlled by an electrostatic imaging process.

Color printer **300** houses four toner cartridges **302** in a rotating carousel **304** that is operational with a photoconductor (OPC) drum **306**. Toner cartridges **302** contain the four main toner colors cyan (C), magenta (M), yellow (Y), and black (K). Although the toner cartridges **302** are illustrated as separate devices inserted into rotating carousel **304**, they may additionally be implemented as a single all-in-one color cartridge that includes the four toner colors. For example, the rotating carousel **304** may represent a single all-in-one color cartridge, while toner cartridges **302** represent separate housings within the all-in-one cartridge for accommodating the four color toners. In addition, OPC drum **306** may be implemented as one or more OPC drums. For example, there may be four OPC drums **306**, one to accommodate the transfer of each color toner.

To begin the imaging process, a primary charge roller **310** within the OPC drum assembly **312** applies an electrostatic charge to the OPC drum **306**. As the OPC drum **306** rotates, a laser assembly **314** writes the latent image for the first color onto the drum **306** with laser **316**. The toner carousel **304** then puts the first color toner cartridge **302** into position for operation with the OPC drum **306**. Within toner cartridge **302**, an agitator (not shown) guides toner to a developer roller **318**. As the developer roller **318** and OPC drum **306** rotate, the toner is developed to the latent image electrostatically formed on the OPC drum **306**.

Each color image is thus developed one at a time on the OPC drum **306**. Also, each color image is transferred one at a time to the rotating intermediate transfer belt (ITB) **308** because of attraction from electric charge on primary transfer roller **320**. Once the four-color image has been built on the ITB **308**, the secondary transfer roller **322** is activated to attract the image away from the ITB **308** and onto the paper in one pass of the ITB **308** over the paper. The paper is guided by guide rollers **324** from a paper tray **326** or external source **328** past the ITB **308** and then through the fuser assembly **330**. The fuser assembly **330** includes two hot rubber fuser rollers **332** that

melt the toner, bonding it to the paper. From the fuser assembly **330**, the paper exits the printer **300** into the output tray **334**.

With each page printed by the color laser printer **300**, supply levels within toner cartridges **302** decrease. A monitoring device **212**, such as an antenna sensor, monitors the level of toner remaining in a cartridge **302** and communicates this information to printer controller **200**. The printer controller **200** uses the information to create reports on the percentage of toner or other marking agent remaining in the cartridge **302**. The printing system **100** (**Figs. 1** and **2**) typically presents the reports upon request to system users through a display on printer **300** or a display on host computer **104**.

Exemplary Methods For Smoothing Sensed Toner Level Values

Having introduced an example system **100** in which an algorithm for smoothing sensed toner levels can be implemented, example methods for implementing the smoothing algorithm will now be described with primary reference to **Figs. 4-8**.

Fig. 4 is a flow diagram illustrating an example of a general method for smoothing toner level sensor **212** (monitoring device) values and setting toner report levels throughout the life of a toner cartridge. Operations included in the method of **Fig. 4** are ideally performed in a system **100** such as that shown in **Figs. 1** and **2**, and are typically implemented on either a print device **102** or a host computer **104**. However, the method operations of **Fig. 4** are not limited to being performed on a single device, but can also be performed alternately between devices such as print device **102** and host computer **104**.

The example method of **Fig. 4** begins at operation **400** with the seeding of a toner report level. As used throughout the various sections of this document, including the summary, the detailed description, and the claims, the word "seeding" and its variants should be generally understood as meaning establishing an initial value. The toner report level is a value reported to a system user indicating the amount of toner or

other marking agent present in a toner cartridge installed in a print device **102**. The toner report level is typically provided as the percentage of toner that remains in the cartridge, and can be presented to a user upon request or at a preset interval. The seeded value is determined by selecting the highest value of one or more initial readings received from a toner level sensor **212** on the toner cartridge. The seeding of the toner report level occurs only one time within any method cycle. A method cycle begins either when a print device **102** is turned on or when a toner cartridge within a print device **102** is replaced. Removal and reinstallation of the same toner cartridge into a print device **102** and opening and closing the toner cartridge door on the print device **102** generally also constitute the beginning of a method cycle.

After the toner report level is seeded, a group of readings from the toner level sensor **212** is averaged at operation **402**. The number of readings used in the averaging is typically experimentally predetermined. The number is preferably large enough that the average value closely represents the actual amount of toner present in the toner cartridge, but is not so large that a point of diminishing returns is reached regarding the accuracy of the average. Thus, eight readings is a preferred number of readings used in the averaging of operation **402**.

At operation **404** the average of the group of readings is compared to the value of the toner report level. If the average is less than the toner report level, the report level is set equal to the average at operation **406**. If the average is not less than the toner report level, the report level is not changed, and operation **408** is executed. Because the seeded value of the toner report level is set to the highest of an initial group of sensor readings at operation **400**, it is expected that the average of the first group of toner sensor level readings will be lower than the report level, and that the report level will therefore be adjusted downward accordingly.

At operation **408**, a subsequent group of readings from the toner level sensor **212** is averaged. The number of readings used in the subsequent group average is

determined as described above, and is generally the same number of readings used in calculating the prior group average. In addition, however, each reading in the subsequent group of readings is required to be within a prescribed percent of the current toner report level. This requirement eliminates outlying sensor readings that are presumed to be inaccurate by virtue of inherent sensor **212** inaccuracies. Therefore, depending on how many outlying readings are eliminated, the number of readings required from the toner level sensor **212** to properly complete the subsequent group of readings may vary. The prescribed percent is preferably +/- 10%, but can be any percent range determined to be statistically significant in eliminating outlying sensor readings. The resulting average calculated from the subsequent group of readings therefore provides a more realistic representation of the actual amount of toner present in the cartridge.

At operation **410** the average of the subsequent group of readings is compared to the value of the toner report level. If the average is less than the toner report level, the report level is set equal to the average at operation **412**. Operation **408** is then repeated. If, at operation **410**, the average is not less than the toner report level, the report level is not changed, and operation **408** is again repeated. The method continues in this manner, repeating operations **408**, **410** and **412** throughout the life of the toner cartridge.

The result of the method illustrated in **Fig. 4** is a continually decreasing, rather than erratic, toner report level that provides accurate information to a system user about the amount of toner remaining in a toner cartridge.

Fig. 5 is a flow diagram illustrating a more detailed example of a method of smoothing toner level sensor values and setting toner report levels throughout the life of a toner cartridge. The flow diagram of **Fig. 5** will be discussed with further reference to flow diagrams in **Figs. 6-8**, which illustrate example implementations of each stage of the method of **Fig. 5**.

The example smoothing method of **Fig. 5** can be initiated in a variety of ways as illustrated in operation **500**. The method is typically triggered by the power up of a print device **102**, the replacement of a print device toner cartridge, or the opening and closing of the cartridge door on the print device **102**. These types of event indicate to the printer controller **200** that the toner level smoothing algorithm is to be initiated or reinitiated if already in progress.

Operation **502** illustrates that the method begins with setting the toner report level to an arbitrarily high value and setting the values for three counts, N, M and Q. The arbitrary toner report level is preferably set at a value higher than 100% and serves to indicate to a user that the toner report level is in an unknown state.

The next operation **504** is that of receiving N toner level sensor **212** readings. The toner report level is then set to the highest of these readings at operation **506**. Operations **504** and **506** serve to seed the toner report level with an initial measured value from the toner level sensor **212**. The number of readings, N, used in selecting the initial measured value is typically experimentally predetermined to provide a high enough seeded toner report level that subsequent operations will decrease, rather than increase, later toner report levels. This helps provide toner level reports that follow a uniform percent degradation in reported amounts of toner over the life of a toner cartridge.

An example implementation of operations **504** and **506** is detailed by the flow diagram of **Fig. 6**. At operation **600**, a counter is initialized (typically to zero) for later comparison to the value set above for count N. At operation **602**, a toner level sensor **212** reading is received, and the toner report level is set to this reading value at operation **604**. The counter is then incremented at operation **606**. Another toner level sensor **212** reading is received at operation **608** and compared to the toner report level at operation **610**. If the toner level sensor **212** reading is greater than the current toner report level, then the toner report level is reset to the value of the reading at operation

612. If not, the toner report level is left unchanged. In either case, the counter is compared to count N, and if the counter has not reached the value of count N, operations **606-614** are repeated, beginning with incrementing the counter at operation **606**. If the counter has reached the value of count N, then the toner report level has been set to the highest of N toner level sensor **212** readings as operations **504** and **506** indicate, and the method of **Fig. 5** moves on with operation **508**.

Referring again to **Fig. 5**, the method continues by receiving M toner level sensor **212** readings at operation **508**. The M readings are averaged at operation **510**. At operation **512**, the average of the M readings is compared to the current toner report level. If the average is less than the toner report level, the toner report level is set equal to the average, thereby adjusting the toner report level downward. If the average is not less than the toner report level, the toner report level is left unchanged. The number of readings, M, used in calculating the average is preferably large enough that the average value closely represents the actual amount of toner present in the toner cartridge, but is not so large that a point of diminishing returns is reached regarding the accuracy of the average. The number eight has been experimentally determined to be a preferred number of readings for averaging at operation **510**.

An example implementation of operations **508-514** is detailed by the flow diagram of **Fig. 7**. At operation **700**, a counter is initialized (typically to zero) for later comparison to the value set above for count M. At operation **702**, a variable used as a pre-average is initialized to zero. This variable will be increased by M number of toner level sensor **212** readings until it is later converted to an average. At operation **704**, a toner level sensor **212** reading is received, and this reading is added to the pre-average at operation **706**. The counter is then checked at operation **708** to determine if it has reached the value set for count M. If the counter has not reached M, it is incremented at operation **710** and operations **740-710** are repeated as needed until the counter reaches count M. When the counter reaches count M, the pre-average is divided by M at

operation **712** to determine the average of the M toner level sensor **212** readings. The average is then compared to the current toner report level at operation **714**. If the average is less than the toner report level, the toner report level is reset to the value of the average at operation **716**. If the average is not less than the toner report level, the toner report level is left unchanged. In either case, the method of **Fig. 5** moves on with operation **516**.

Referring again to **Fig. 5**, the method continues by receiving Q toner level sensor **212** readings at operation **516**. However, each of the Q readings is screened to ensure that it falls within a certain prescribed percent of the current toner report level. The screening further refines the accuracy of the toner report level by eliminating outlying sensor **212** readings that are presumed to be inaccurate by virtue of inherent sensor **212** inaccuracies. Depending on how many outlying readings are eliminated, the number of readings required from the toner level sensor **212** to complete a group of properly screened Q readings may vary. The prescribed percent is preferably +/- 10%, but can be any percent range determined to be statistically significant in eliminating outlying sensor readings.

The Q readings are averaged at operation **518**. The number of readings, Q, used in calculating the average is preferably large enough that the average value closely represents the actual amount of toner present in the toner cartridge, but is not so large that a point of diminishing returns is reached regarding the accuracy of the average. The number eight has been experimentally determined to be a preferred number of readings for averaging at operation **518**.

At operation **520**, the average of the Q readings is compared to the current toner report level. If the average is less than the toner report level, the toner report level is set equal to the average, thereby adjusting the toner report level downward. If the average is not less than the toner report level, the toner report level is left alone. In either case, the method then repeats operations **516-522** throughout the remaining life of the toner

cartridge, or until an event occurs which reinitiates the method as illustrated by operation **500**. As the method continually cycles through operations **516-522**, the toner report level accurately and uniformly decreases.

An example implementation of operations **516-522** is detailed by the flow diagram of **Fig. 8**. At operation **800**, a counter is initialized (typically to zero) for later comparison to the value set above for count Q. At operation **802**, a variable used as a pre-average is initialized to zero. This variable will be increased by Q number of toner level sensor **212** readings until it is later converted to an average. At operation **804**, a toner level sensor **212** reading is received. This reading is screened at operation **806** to ensure that it falls within a certain prescribed percent (preferably +/- 10%) of the current toner report level. If the reading does not fall within the prescribed percent of the toner report level, another toner level sensor **212** reading is received and similarly evaluated, as operations **804** and **806** are repeated.

When a reading falls within the prescribed percent, it is added to the pre-average at operation **808**. The counter is then checked at operation **810** to determine if it has reached the value set for count Q. If the counter has not reached count Q, it is incremented at operation **812**, and operations **804-812** are repeated as needed until the counter reaches count Q. When the counter reaches count Q, the pre-average is divided by Q at operation **814** to determine the average of the Q toner level sensor **212** readings. The average is then compared to the current toner report level at operation **816**. If the average is less than the toner report level, the toner report level is reset to the value of the average at operation **818**. If the average is not less than the toner report level, the toner report level is left alone. In either case, the method returns to operation **800** and repeats operations **800-818** throughout the remaining life of the toner cartridge, resulting in an accurate and uniform decrease in the toner report level.

Throughout the operation of the methods described above, toner level sensor **212** readings can be received passively or actively. In a passive sense, the readings are

received when the toner level sensor **212** senses a change in the toner level. The readings are therefore "pushed" from the toner level sensor **212** when a change in the value of the toner level is sensed. A reading is typically pushed at least as often as the printing of each page by a print device **102**. In an active sense, the readings are requested from the toner level sensor **212** at a preset interval. The readings are therefore "pulled" from the toner level sensor **212**. The interval can be based on a period of time or on an event such as the printing of each page.

In addition, throughout the operation of the methods described above, the toner report level can be reported to a system user upon request by the user, or at a preset interval. Typically, requests for the toner report level are made either at a display panel on the print device **102**, or at the host computer **104**. The toner report level can be displayed at either location. Toner report levels displayed at preset intervals can be displayed based on intervals of time (e.g., every week), or based on events (e.g., every 1000 printed pages).

Although the description above uses language that is specific to structural features and/or methodological acts, it is to be understood that the invention defined in the appended claims is not limited to the specific features or acts described. Rather, the specific features and acts are disclosed as exemplary forms of implementing the invention.